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Swedish University of Agricultural Sciences

Department of Ecology

# **The work with conservation of genetic diversity at Swedish official agencies**

– comparing practices with regulations

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## Abstract

It is widely recognized that the ability for species and populations to adapt to changes in their environment is correlated with their genetic variation. Despite this, genetic diversity is rarely taken into consideration in the practical management of biodiversity or in the legislation controlling the management. Even in cases when genetic diversity is protected by law, other issues are often prioritized. In Sweden, the neglect of the need to monitor genetic diversity is extra alarming as many of the species found here are on the border of their range and may be extra sensitive to changes in the environment.

In this thesis work, a questionnaire study was performed among officials working with nature conservation at Swedish County Administrative Boards (CABs) and Municipalities. The study aimed at investigating if officials are working with conserving genetic diversity, how such questions are identified, by who they are identified, what species they concern and if the officials are satisfied with their work. A literature review was also performed, aiming at investigating how genetic diversity is protected by Swedish legislation. The answers from the questionnaire survey were compared to the legislative obligations described in the literature review and analyzed for differences between the target groups.

The literature review showed that very few parts of the Swedish legislation explicitly cover genetics, but that several sections indirectly cover the topic. The questionnaire survey showed that all officials at the CABs had made decisions about the need to monitor and/or conserve genetic diversity, whereas most officials at the Municipalities had not. Officials at CABs often had colleagues with similar knowledge about genetics as themselves, whereas officials at the Municipalities did not. At the CABs, officials had only discussed the genetics of species that are endangered and protected by law. At the municipalities, both rare and common species had been discussed in terms of genetics. At both levels of governance, most officials were uncomfortable with their own and their colleagues ability to identify matters of concern that are related to genetic diversity. Most officials were also discontent with how questions concerning genetics are managed at their place of work and think that their knowledge concerning genetics could be enhanced.

Already in 2006, the Swedish Environmental Protection Agency called for a National Secretariat that would deal with genetic diversity. The results from this thesis work indicate that such a national center for counseling in genetic conservation would be valuable, as officials at all governmental levels would then be able to contact it and get advice concerning conservation of genetic diversity. Apart from giving advice to officials in need for it, the center could also be responsible for arranging courses to further enhance the knowledge in genetics possessed by officials at all governmental levels, thus further enhancing the ability of officials to make well-grounded decisions.

*Key words:* genetic diversity, conservation, questionnaire survey, official agency

## Populärvetenskaplig sammanfattning

Det är knappast någon nyhet att jordens klimat och ekosystem just nu genomgår stora och snabba förändringar. Inom biologin är det allmänt erkänt att det finns ett samband mellan den genetiska variationen hos en art eller population, och dess förmåga att anpassa sig till förändringar i livsmiljön. Trots detta tar man sällan hänsyn till den genetiska variationen i det praktiska arbetet med att bevara biologisk mångfald och ekologiska system. Lagstiftningen kring dessa frågor har också luckor vad gäller bevarande av genetisk variation, och i de fall då genetisk mångfald faktiskt skyddas enligt lag är trenden att andra frågor ofta prioriteras. I Sverige är detta försummande av den genetiska mångfalden extra oroväckande eftersom många av de arter som finns här befinner sig på gränsen av sina utbredningsområden. Sådana gränspopulationer av arter har ofta unika genetiska sammansättningar och kan därför vara särskilt skyddsvärda.

I detta examensarbete har en enkätundersökning genomförts bland tjänstemän som arbetar med naturvård på svenska länsstyrelser och kommuner. Studiens syfte var att undersöka om de personer som arbetar med bevarandefrågor också arbetar med bevarande av genetisk variation. Enkätfrågorna handlade också om hur tjänstemännen har kommit i kontakt med frågor där det funnits ett behov av att bevara genetisk variation, vem som generellt sett har identifierat att det finns ett behov av att ta hänsyn till genetik i ett visst fall, samt vilka arter som har varit aktuella. Tjänstemännen fick också beskriva om de var nöjda med det arbete de utförde och om de kände sig trygga med sin egen och sina kollegors förmåga att ta ställning i frågor som rör bevarande genetisk mångfald.

Förutom enkätundersökningen så ingick en litteraturstudie i examensarbetet. Litteraturstudien syftade till att undersöka hur den genetiska variationen är skyddad enligt svensk lag. Svaren från enkätundersökningen jämfördes sedan med de skyldigheter som återfunnits i lagstiftningen, och analyserades även för skillnader mellan den de två olika myndigheterna. I litteraturstudien framkom att den svenska lagstiftningen endast i undantagsfall ger ett uttryckligt skydd för genetisk variation. Däremot finns ett antal ställen i lagtexterna där det är möjligt att tolka formuleringarna som ett skydd för genetisk variation.

Resultaten från enkätundersökningen visade att tjänstemännen på kommuner och länsstyrelser hade ungefär samma könsfördelning och utbildningsnivå inom genetik. En skillnad mellan de två myndigheterna var att tjänstemännen på länsstyrelserna oftast hade kollegor som också hade kunskaper i genetik, medan de anställda på kommunerna tenderade att vara de enda på sin arbetsplats som besatt den typen av kunskaper. Enkätundersökningen visade också att samtliga tjänstemän på länsstyrelsenivå någon gång hade fattat beslut som rörde ett eventuellt behov av att övervaka och/eller bevara genetisk variation hos en art eller population. På den kommunala nivån hade däremot majoriteten av tjänstemännen inte fattat något sådant beslut. Det fanns även skillnader mellan vilka arter som hade diskuterats i termer av genetik på de två myndigheterna. På länsstyrelserna hade samtliga tjänstemän endast arbetat med arter som är hotade på ett eller annat sätt, och som därmed är

skyddade enligt lag. På kommunerna däremot hade såväl oskyddade som skyddade arter diskuterats i termer av genetik. På båda myndighetsnivåerna angav de flesta av undersökningens deltagare att de varken var bekväma med sin egen eller sina kollegors förmåga att identifiera frågor som berör genetisk variation. Majoriteten var också generellt missnöjda med hur frågor som rör genetisk variation hanteras på deras arbetsplats. Huvuddelen av de tillfrågade ansåg även att deras egna kunskaper om genetik skulle kunna förbättras.

Att bevarande av genetisk variation är ett bortglömt område inom den svenska förvaltningen är inget nytt, redan år 2006 rapporterade Naturvårdsverket att man såg ett behov av att instifta ett nationellt sekretariat som skulle fokusera helt på frågor som rör genetisk variation om man ville uppfylla de behov som fanns inom området. År 2012 hade något sådant center fortfarande inte bildats, vilket delvis är bakgrunden till detta examensarbete, det var helt enkelt intressant att ta reda på hur situationen ser ut sex år efter att Naturvårdsverket rapporterat om ett behov som fortfarande inte blivit tillgodosett. I den ursprungliga rapporten från Naturvårdsverket refererades dock bara till det arbete som sker på länsstyrelserna, medan arbetet på den kommunala nivån helt förbisågs. Den kommunala nivån är dock nog så viktig i det svenska bevarandearbetet, inte minst för att merparten av det arbete som rör plan- och byggärenden ligger på den nivån. Detta var orsaken till att den kommunala nivån togs med i undersökningen från början, och resultatet av det beslutet har visat sig lyckat i och med att andra aspekter på bevarandearbetet har kunnat belysas. Inte minst har det varit intressant att kunna påvisa skillnaderna mellan hur kommuner och länsstyrelser arbetar, och se att man på den kommunala nivån tar hänsyn även till arter som inte är nationellt hotade på ett helt annat sätt än vad man har på länsstyrelsenivån.

Resultaten från detta examensarbete understryker också att ett sådant nationellt centrum för rådgivning i genetisk bevarande som föreslogs redan år 2006 skulle vara mycket värdefullt, eftersom tjänstemän på alla statliga nivåer skulle då kunna kontakta dem och få råd i frågor som rör genetisk variation. Inte minst för den kommunala nivån skulle detta kunna vara värdefullt, eftersom tjänstemännen där ofta saknar tillräckligt kunniga kollegor att diskutera dessa frågor med. Förutom att ge råd till behövande tjänstemän så skulle ett nationellt centrum också kunna ansvara för att tjänstemän på alla statliga nivåer fick fortbildning inom ämnet genetik, vilket också behövdes enligt enkätundersökningen. Väl utbildade tjänstemän som är trygga i sina roller och som vid behov kan få stöd i sitt beslutsfattande av andra väl utbildade personer är själva grunden för ett rättsäkert samhälle, inte minst när det rör förvaltningen av något så komplext som den genetiska variationen i våra vilda växt- och djurpopulationer.



## Table of contents

<b>1</b>	<b>Introduction</b>	<b>9</b>
1.1	Specific objectives .....	12
1.2	Hypotheses.....	13
<b>2</b>	<b>Materials &amp; Methods</b>	<b>15</b>
2.1	Literature review .....	15
2.2	Questionnaire study.....	15
2.2.1	Selection of target groups.....	16
2.2.2	Distribution of the questionnaire survey.....	17
2.2.3	Data analysis .....	17
<b>3</b>	<b>Results</b>	<b>18</b>
3.1	Literature Review .....	18
3.1.1	The Convention on Biological Diversity .....	18
3.1.2	National legislation .....	20
3.2	Questionnaire study.....	23
3.2.1	Demographic data .....	23
3.2.2	Genetic knowledge .....	24
3.2.3	Work with genetic diversity .....	25
3.2.4	Species.....	28
3.2.5	Situation at work place .....	30
<b>4</b>	<b>Discussion</b>	<b>33</b>
4.1.1	Are officials working with genetics? .....	33
4.1.2	Type of genetic resources .....	34
4.1.3	Species.....	35
4.1.4	Situation at work place .....	37
4.1.5	Legislative obligations to conserve genetics.....	37
4.1.6	Methodology.....	39
4.1.7	Potential for further studies.....	42
4.1.8	Proposal for a National Centre for Conservation of Genetics .....	43
	<b>References</b>	<b>46</b>
	Publications .....	46
	Legislations.....	47
	Online .....	48
<b>5</b>	<b>Appendices</b>	<b>49</b>
5.1	Appendix 1: Letter of information to participants in the questionnaire study .....	49
5.2	Appendix 2: Questionnaire survey including all questions .....	50
5.3	Appendix 3: List of municipalities with common offices for environmental work .....	63
5.4	Appendix 4: List of species mentioned in the survey .....	64
5.5	Appendix 5: Translations of Swedish legal terms .....	67



# 1 Introduction

Biological systems all over the world are currently undergoing large changes, mainly as a result of human activities, ranging from local alterations in land use to global climate change. It is widely recognized that the ability for species and populations to adapt to such changes, either through evolutionary or plastic responses, is correlated with their genetic variation (Frankham et al, 2009). However, genetic diversity within populations and species are rarely taken into consideration, neither in legislation nor in practical management of biodiversity and ecological systems (Laikre et al, 2008).

The need to monitor genetic diversity is commonly overlooked in large parts of the world, including many of the countries that have signed the Convention of Biological Diversity (Laikre, 2010b). However, even in countries that claim to consider national or international legislation on the protection of genetic diversity, other conservation issues are often prioritized (Laikre, 2010b). Laikre et al (2010a) studied a sample of the National Biodiversity Strategy and Action Plans in which members of the CBD outline how they intend to implement the treaty. Ten out of 24 countries mentioned genetic diversity of wild animals and plants and only five countries recognized the need to monitor genetic diversity (Laikre et al 2010a). As stated in Laikre et al (2010b), this internationally widespread neglect must influence the practical management of genetic diversity, despite the widespread awareness of the importance of this level of diversity.

In Sweden, a neglect of the need to monitor genetic diversity is extra alarming, as many of the species found in the country are already living on the northern border of their range and therefore appear in genetically distinct populations (the Swedish Environmental Protection Agency, 2010). Given the assumed upcoming changes caused by ongoing climate change, populations living at the border of their species range are likely to be among the precursors as climate changes enable and/or force migration into new territories. The ability to adapt to the challenges

found in the new habitat will be dependent on the genetic diversity available among the migrating individuals. Thus, conserving the genetic variation of populations living at the border of their range may prove crucial both for the persistence of species, in the long run, for whole ecosystems and their ecosystem services, which are crucial to the survival of the human society as we know it. Despite this, Laikre (2010b) stated that also in Sweden, legislative obligations to conserve genetic diversity are often not fulfilled. Two examples of parts of the legislation that are often overlooked are the internationally binding treaty *the Convention on Biological Diversity*, and its Swedish implementation, the Swedish Environmental Objective *A Rich Diversity of Plant and Animal Life* (Prop 2004/05:150) (Laikre, 2010).

There may be many reasons as to why genetic aspects are not taken into account in conservation. For example, people working with conservation planning and management may not be aware of the importance of genetics in biodiversity, they may consider other factors more important or they may simply lack the knowledge on what to do and how. In 2006, the Swedish Environmental Protection Agency performed a questionnaire study attempting to answer these questions. The questionnaire was distributed among officials at Swedish County Administrative Boards and the Swedish Board of Fisheries, as a part of the development of the *Proposal for a National Action Plan for Conservation of Genetic Variation in Wild Plants, Animals and Fungi* (Environmental Protection Agency, 2006). The study revealed that all participants considered it important to conserve genetic variation in wild plants and animals, and most of them also considered it equally or more important to ensure variation on a genetic level than on a species level. Furthermore, it was concluded that officials at County Administrative Boards are very well familiar with the theoretical aspects of genetic processes and management. Thus, the officials participating in the study were aware of the importance of genetic aspects and they understood the need to prioritize genetics in conservation of biological diversity. Despite all this, even studies that only examine the broad picture from an international perspective have shown that little is done in practice to conserve the genetic diversity in Sweden (Laikre, 2010).

Also, there are issues with the study performed in 2006. First, the study was directed at a rather small target group, only consisting of officials working at the Swedish County Administrative Boards and the Swedish Board of Fisheries. The direction of the study towards only these two groups meant that a very large group of Swedish officials that are working with nature conservation, and potentially also with conservation of genetic variation, were excluded from the study, namely

ecologists and biologists at the 290 Swedish municipalities. Hence, it is interesting to broaden the perspective and to investigate how genetic aspects are taken into consideration in the conservation work performed at Swedish municipalities. This view is supported by Andersson et al (2007), who included the municipal level of government by stating that “This report is directed towards people engaged in the management of natural resources, nature conservation and sustainable development at agencies, municipalities and interest-, and non-profit organizations [my translation]”. However, neither Andersson et al (2007) nor anyone else has actually studied how the Swedish Municipalities work with conserving genetic diversity.

In addition to just finding out what is done at the Municipalities in terms of conserving genetic diversity, it is also interesting to compare the work performed at the Municipal level with the work performed at County Administrative Boards, as several parts of the Swedish legislation gives both institutions responsibility for the nature conservation in Sweden (Ordinance on Environmental Supervision (2011:13), Swedish Environmental Code (1998:808) etc.) but gives the Municipalities a more executive role on the local scale of the land management in Sweden (Hahn et al, 2006). Thus, one might expect to find differences in the work performed at the two levels of government, with a more “hands on” approach to nature conservation at the municipal level and a more theoretical and delegating approach at the County Administrative Boards.

Another aspect that was not covered in the study performed in 2006 was the practical work performed by the people in the target groups. Instead, the study mainly focused on the theoretical knowledge of the surveyees. Although that approach may have been well suited for the development of the *Proposal for a National Action Plan for Conservation of Genetic Variation in Wild Plants, Animals and Fungi*, the study from 2006 only appear to have resulted in a few reports, i. e. the *Proposal for a National Action Plan for Conservation of Genetic Variation in Wild Plants, Animals and Fungi* (Environmental Protection Agency, 2006) and *Genetic variation in wild plants and animals in Sweden* (Andersson et al 2007 [my translation of the title]). The practical work could probably still be improved in many ways and actions to improve it could probably be more precise if more was known about what is really done. In addition, there is still no national secretariat, which was the main improvement to the practical work suggested in the study from 2006. Thus, the practical work with conserving genetic variation performed at the County Administrative Boards may still be in the same state as it was in 2006. It is therefore necessary to find out what is done in practice to conserve genetic diversity, how this work is performed and what officials working with these

questions think of the work they do. Furthermore, as the work performed by officials at Swedish County Administrative Boards and Municipalities is regulated by several sections of the Swedish legislation. Thus, it is important to thoroughly investigate what these regulations state, and to compare this to the work performed at the different governmental levels.

## 1.1 Specific objectives

In this thesis work, a questionnaire study was performed among officials working with nature conservation at Swedish County Administrative Boards and Municipalities. The study aimed at investigating how the work with conserving genetic diversity is performed at these two governmental institutions, in order to identify aspects of the work that could be improved and measures that could enhance the work with including genetic aspects into the conservation work. In order to fully understand the work performed, several aspects were studied, such as if officials are working with conserving genetic diversity at all, how such questions are identified, by who they are identified, and what species they concern. In addition, the officials that participated in the study were asked if they are satisfied with their own work concerning the conservation of genetic diversity, and how this work could be improved.

In addition, a literature review was performed, which aimed at investigating how genetic diversity is protected in the Swedish legislation. The answers from the questionnaire study were then compared to the legislative obligations described in the literature review. All results from the questionnaire study were analyzed for differences between the target groups.

The questions that were in focus in the study are:

1. Do officials at County Administrative Boards and Municipalities take genetic processes into consideration in their work with nature conservation? Are there any differences between the groups in terms of how often this occurs?
2. Are there differences between County Administrative Boards and Municipalities regarding the type of genetic resources that are taken into consideration in the conservation work? Do both institutions identify such resources in the same way?
3. Are the same species taken into account at both governmental levels?

4. Are there any differences in how confident and/or satisfied officials at County Administrative Boards and Municipalities are with their work regarding conservation of genetic resources?

## 1.2 Hypotheses

As stated above, genetic diversity within populations and species is often overlooked in the practical management of biodiversity and ecological systems, even in cases where the topic of genetic diversity is covered in the legislation (Laikre, 2010). In accordance with the more general findings of Laikre, the questionnaire survey is expected to reveal a situation where, in general, little is done in terms of protecting genetic diversity due to officials lacking the means and/or knowledge to perform this work in a satisfying way. Furthermore, the survey is expected to reveal differences between the work performed at the two governmental levels, since the two levels of governance are structured in very different ways and have slightly different legislative obligations.

More precisely, it is expected that the study will reveal the following:

1. Both groups of officials are expected to take genetic processes into consideration in their work with nature conservation. However, officials at County Administrative Boards are expected to do so more often, as the County Administrative Boards have a more direct responsibility for these matters according to the legislation (Ordinance on Environmental Supervision (2011:13)), whereas the Municipalities have a much more general responsibility for nature conservation, in which genetics is more implicitly than explicitly covered.
2. It is expected that different types of genetic resources are taken into consideration at the two levels of governance. Officials at Municipalities are generally expected to work less directly with conserving genetic diversity, as their legislative responsibilities for nature conservation are broader. Since the County Administrative Boards have the national responsibility for the Swedish Action Plans for Threatened Species, they are expected to be working more with species that have Action Plans than the Municipalities do. In contrast, the Municipalities are expected to consider Red Listed species more often than the County Administrative Boards, as such species are to be taken into consideration during the Environmental Impact Assessments which are often the

responsibility of the Municipalities in their work with local and municipal comprehensive plans (Planning and Building Act (2010:900)).

## 2 Materials & Methods

### 2.1 Literature review

The literature review started off by searching the sections in the legislation referred to by Andersson (2007) in the section 9.1 *What taxa need surveillance?* for any references to genetic issues. The documents listed in that section are: The habitat directive (EU directive 92/43/EEG, the Ordinance on Protection of Areas in accordance with the Swedish Environmental Code etc. (1998:1252) and the Government bill 2005/05:150. The search process was then extended to all further references to documents found in the examined sections of the legislation, as were several other documents and publications that showed up during the search, including the Ordinance on Environmental Supervision (2011:13), The Ordinance on Protection of Species (2007:845), the Swedish Environmental Code and Michanek and Zetterberg (2008). All references that were used in the Literature review are found in the reference list, and their Swedish names are found in Appendix 3. All sections of the legislation referred to in this thesis work are taken from the web page for legal codes, [www.notisium.se](http://www.notisium.se).

### 2.2 Questionnaire study

The questionnaire study was directed towards officials at County Administrative Boards and municipalities in Sweden and consisted of 29 questions aiming at investigating how these institutions are working with conserving genetic diversity. The full study including all questions can be found in Appendix 2.

The study was performed using the online “survey generator” provided by the Swedish University of Agricultural Sciences at [enkater.slu.se](http://enkater.slu.se) and the link was

then e-mailed to officials working with nature conservation at County Administrative Boards and municipalities in Sweden.

### 2.2.1 Selection of target groups

The target group consisted of people working with nature conservation at two different levels in the Swedish governmental system, at County Administrative Boards and municipalities, respectively. Both target groups were contacted through e-mail and only one person was contacted at each office in order to ensure that individual answers were independent from each other. E-mail addresses were gathered from the home pages of administrative boards and municipalities. Since some Swedish municipalities collaborate in their environmental work and have the same contact person for nature conservation, only 274 officials at the Municipality level were contacted, although Sweden has 290 municipalities. In total, 295 officials were contacted at the two administrative levels, 274 from the municipal level and 21 from the level of County Administrative Boards.

#### *Selection of contact person at County Administrative Boards*

The contact person on the page for Action Plans for Threatened species at the homepage of each of Sweden's 21 administrative boards was selected. Most often, this page was found by clicking: Djur & Natur > hotade växter och arter > hotade djur > åtgärdsprogram

If more than one contact person was listed, the one first mentioned was contacted. In cases when no e-mail address could be found at the home page of the administrative board, the e-mail address was created using the standard form of [firstname.lastname@lansstyrelsen.se](mailto:firstname.lastname@lansstyrelsen.se) and then googled using the search for exact phrase-function in order to check for validity.

#### *Selection of contact person at municipalities*

Each of the 290 municipalities' homepages was searched for employees working with nature conservation or environment. All visits to these homepages started with a search for the phrase "naturvård" using the "search this homepage"-function. Sometimes this was enough; often more work had to be done as the homepages of Swedish municipalities are varying a lot in appearance and organization. Often, only the name of the responsible official could be found at the homepage, without any contact information. In those cases, the same method was used as in the case of County Administrative Boards, but with the exception that the standard form was [firstname.lastname@municipalityname.se](mailto:firstname.lastname@municipalityname.se) and then

googled. In some cases, this method did not generate a functioning address, and instead, the general address to the Environmental Protection Office or the Community Development Office was used.

Some Swedish municipalities collaborate in their environmental work, usually through a Common Board and Administrative Organization and have only one office and sometimes also only one contact person for nature conservation. For this reason, only 274 officials at the Municipality level were contacted, although Sweden has 290 municipalities. These common offices are listed in table 1 below. Furthermore, Gotland has a common office for its County Administrative Board and Municipality and was therefore only contacted once. Full lists of the Municipalities which have common offices for environmental work are listed in Appendix 3.

### 2.2.2 Distribution of the questionnaire survey

An e-mail presenting the study and the URL to the page where the survey could be filled in was sent to the target groups described above. During the month when the survey was open, two e-mails of reminder were sent to the target groups. The e-mail presenting the study can be found in Appendix 1.

### 2.2.3 Data analysis

The results from the questionnaire survey were analyzed using the Fisher's Exact test with the Freeman-Halton extension of the test, allowing tests of contingency tables with two-rows by three-columns. Tests were performed using the online tool for statistical computation provided at <http://vassarstats.net/>. The form used for this analysis can be found here: <http://vassarstats.net/fisher2x3.html>.

Vassarstats was also used to analyze the distribution of genders between the target groups. For this, the form for 2x2 Fisher's Exact test found at <http://vassarstats.net/tab2x2.html> was used.

All graphs were constructed using Microsoft Excel 2009.

## 3 Results

### 3.1 Literature Review

The topic of conservation of genetic diversity is covered in several parts of both international and Swedish legislation, mainly in the Convention of Biological Diversity, the Swedish Environmental Quality Objectives, and the Swedish Environmental Code and its ordinances. In this section, the parts of these documents that cover the legislative obligations and subsequent implementations to conserve genetic diversity are summarized.

#### 3.1.1 The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is an international convention obligating its parties to strive for the conservation and sustainable use of biological diversity. The CBD is the first global agreement to deal with biological diversity, and by dividing it into the three levels of ecosystems, species and genes, also the first to cover the topic of genetic diversity (Glowka et al, 1994).

#### *The Environmental Quality Objectives*

Since the CBD is an internationally binding convention, the nations that have signed it are obliged to develop strategies and plans for its fulfillment on a national level. Consequently, as Sweden has signed the CBD, the convention has had to become integrated in the national legislation. This has mainly been done through the 16 Swedish Environmental Quality Objectives and their interim targets (Prop 1997/98:145 & Prop 2000/01:130). The aspect of genetic diversity is primarily covered in the 16th Environmental Quality Objective, A Rich Diversity of Plant and Animal Life (Prop 2004/05:150), stating that “*Species must be able to survive in long-term viable populations with sufficient genetic variation*” and listing sev-

eral desired outcomes. From a genetic conservation point of view, interesting factors are: dispersal pathways both in terrestrial and aquatic landscapes containing sufficient numbers of habitats to maintain long-term viable populations, restorations of valuable habitats, and conservation of species within their natural range to ensure sufficient genetic variation within and between populations (Ministry of the Environment, 2009).

The Swedish Environmental Quality Objectives are to be implemented at all levels of governance, ranging from national to local levels. At the regional level, the County Administrative Boards have a coordinating role in the work with the Environmental Objectives and are regionally responsible for the objectives. In this work, they should cooperate with other regional authorities and communicate with municipalities, the business world, non-governmental organizations and other parties in the county. The County Administrative Boards should also help the municipalities to formulate local goals and action plans. Furthermore, County Administrative Boards are responsible for the follow-up of the work with the goals in the region (<http://www.miljomal.nu/Vem-gor-vad/Lansstyrelserna/>).

In a recent evaluation performed by the Swedish Environmental Protection Agency, it was concluded that many more of the environmental objectives could be fulfilled if the extent and quality of the work with them could be increased at County Administrative Boards. This however, would require that the County Administrative Boards were given more authority in their work (Environmental Protection Agency, 2012).

At the municipal level, the work with the Swedish Environmental Objectives consists in translating national and regional goals into local goals and actions (<http://www.miljomal.nu/Vem-gor-vad/kommunerna/>). A questionnaire survey directed at officials in all Swedish municipalities revealed that 84 % of the Swedish municipalities were working with the Environmental Objectives in early 2006, often in cooperation with County Administrative Boards, local organizations and companies (Swedish Association of Local Authorities and Regions, 2006). At the time of the survey, roughly one third of the municipalities had made their own objectives based on the national and regional environmental objectives, and almost 40% declared that they were in the process of doing so. In addition, approximately one out of ten municipalities had objectives that were not based on the national environmental objectives, which often had been adopted before the creation of the national objectives. Most officials had a positive attitude towards both the national and regional environmental objectives (Swedish Association of Local Authorities and Regions, 2006).

Despite the positive situation at the Municipality level, Bretzer et al (2006) found that the awareness of the local work with environmental objectives was very low in the general public. Officials at the municipalities considered this to be an effect of difficulties with communicating the environmental objectives and creating interest in the work associated with them. The Environmental Protection Agency (2007) confirms this problem and concludes that the work with environmental objectives at the Municipality levels requires a commitment beyond the environmental supervision that is required by the legislation. How such a commitment shall be obtained is not specified.

### 3.1.2 National legislation

Apart from the international obligations to conserve genetic diversity through the CBD and its Swedish implementation in the Swedish Environmental Objective, regulations concerned with genetic diversity can also be found in other parts of the Swedish national legislation. The Swedish Environmental Code (SFS 1998:808) and the ordinances associated with it are the main sections of the legislation covering the topic.

The Swedish Environmental Code (SFS 1998:808) was adopted in 1998 and entered into force in 1999. Before, its contents had been divided into several different regulations, which were neither systematically constructed nor consistent with each other (Michanek & Zetterberg, 2008). Most of the regulations in the Environmental Code are not explicitly focusing on genetic diversity, but may for example concern protection of biological diversity, which in accordance with the CBD involves the component of genetics (Glowka et al, 1994).

#### *The Ordinance on Protection of Areas*

The Ordinance on Protection of Areas in accordance with the Swedish Environmental Code etc. (1998:1252) is one of the regulations associated with the Environmental Code, which covers the protection of genetic resources. The Ordinance refers to several international treaties (§15) and states that authorities are responsible for maintaining or restoring a “favorable conservation status” in areas protected by national legislation or international treaties (§16). Although the concept of favorable conservation status is rather vague, especially in relation to genetic diversity, its definition as stated in the Ordinance, §16, can be argued to also include genetics (Andersson et al, 2007).

The Ordinance on Protection of Areas in accordance with the Swedish Environmental Code etc. (1998:1252) also contains the perhaps most profound state-

ment for the conservation of genetic diversity in the Swedish legislation. In the 15§ of the Ordinance, it is stated that the authorities shall prioritize protection of areas that are particularly valuable according to the Swedish Environmental Code (SFS 1998:808) 7th chapter, 28§, that is, that are listed as prioritized in the future protection work due to specific values in accordance with the Bird directive (Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds), the Habitat directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) or other international responsibilities or national goals on protection of natural habitats. Since the Convention on Biological Diversity is international treaty, it may be argued that the statements in the Ordinance's 15§ can be extrapolated into also involving genetic diversity. As areas covered in 15§ should undergo an environmental impact assessment if they are to undergo any changes, one may also argue that the aspect of genetics should be taken into account in environmental impact assessments, at least in cases where genetically valuable populations or species are present.

In its 16<sup>th</sup> paragraph, the Ordinance on Protection of Areas (1998:1252) further states that authorities are responsible for maintain or restoring a "Favorable conservation status" in areas protected by national legislation or international treaties. Species or habitats listed in the Ordinance on Protection of Species (2007:845), Appendix 1, or in (SFS 1998:1252), Appendix 4 are to be treated with extra care. Since the Ordinance on Protection of Species is the part of Swedish legislation putting the Bird and Habitat directives into action and connecting them to chapter 8 in the Swedish Environmental Code, the statement in the Ordinance is supported by both national and international legislation (SFS 2007:845).

The Swedish legislation provides only a rather vague definition of the concept of favorable conservation status, not the least in relation to genetic diversity. Andersson et al (2007) even states that a clear definition of the correlation between favorable conservation status and genetic diversity is missing altogether. The concept of favorable conservation status was originally found in the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, article 1, and is applicable to both habitats and species. The concept is defined in the 16th paragraph of the Ordinance on Protection of Areas (SFS 1998:1252) as: "The conservation status of a species refers to the sum of the factors that are influencing the species in question and which may in the long run affect its natural distribution and the sizes of its populations" [my translation]. The ordinance defines that a species has a favorable conservation status when the population trends indicate that the species will remain a viable part of its habitat in the long run, the nat-

ural or traditional range of the species is stable, and sufficiently large habitats are available to host populations of the species, both now and in the future.

### *The Ordinance on Environmental Supervision*

The Environmental Code also directs how the fulfillment of its regulations should be supervised by stating that the supervision of the regulations in the Code and the ordinances, judgments and other decisions associated with the Code shall be ensured by the responsible agency (SFS 1998:808; 26:1). In the Ordinance on Environmental Supervision (2011:13), §3, a subject for supervision is defined, but in a way that does not fully cover the term environmental supervision (Michanek and Zetterberg, 2011). Still, the regulatory agency is sometimes also responsible for evaluating the status of the protected object. Furthermore, the regulatory agency is responsible for making sure that the purposes of the Code are fulfilled, by, for example providing counseling and information. In cases where the Code is violated, the regulatory agency is responsible for reporting this to the police or the Office of the Public Prosecutor. When it comes to environmental supervision, the responsible agency can be the Swedish Environmental Protection Agency, the County Administrative Boards, the Municipalities or other public authorities.

The responsibility for the supervision is divided between the different agencies and is described in more detail in the Ordinance on Environmental Supervision (2011:13), chapter 2. In chapter 2, 6-10§§, the responsibilities for protection of areas and species of animals and plants are divided between, among others, County Administrative Boards and Municipalities.

The Ordinance on Environmental Supervision also gives directions on supervision guidance (Ordinance on Environmental Supervision 3:2-14, and 16). This supervision guidance shall concern the applications of the Environmental Code, its Ordinances and related EU regulations. Authorities on a central state level shall give special support to the County Administrative Boards, in their supervision guidance to the municipalities (3:1, third paragraph). In accordance with the Ordinance on Environmental Supervision 3:2, it is generally the responsibility of the Swedish Environmental Protection agency to give supervision guidance to municipal committees and County Administrative Boards.

The supervision that shall be performed by the County Administrative Boards is directed in the Ordinance on Environmental Supervision 2:7-8. For example, the following fields of responsibilities are mentioned: nature reserves, natural monuments, legal habitat protection areas, plant and wildlife sanctuaries and water protection areas that have been set up by the County Administrative Boards. Further-

more, supervision of national parks, environmental protection areas which are not under the responsibility of the municipalities or the Surgeon General and species protection in accordance with the Environmental Code, 8:1-4 are all the responsibility of the County Administrative Board. In the Ordinance on Environmental Supervision 2:29-30 it is also made clear that County Administrative Boards are responsible for supervising a number of other activities that may influence the environment.

As for the supervision guidance, it is stated in the Ordinance on Environmental Supervision 3:16 that the County Administrative Boards are responsible for this in their county. In this responsibility, support directed at the Municipalities and the development of their fields of supervision is included.

At the municipal level, the municipal committees are responsible for supervision in accordance with the Ordinance on Environmental Supervision 2:9. These responsibilities include, among other things, nature reserves, natural monuments, water protection areas and legal habitat protection areas which were put into force by the Municipality. This is also the case for plant and wildlife sanctuaries initially put into force by the Municipality in accordance with the Environmental Code 7:12. Furthermore, municipal committees are also responsible for supervision for several other activities related to the environment, which are listed in the Ordinance on Environmental Supervision 2:31-32.

In addition, the responsibility for supervision of certain objects may be transferred from a regulatory agency to a municipal committee, in accordance with the Ordinance on Environmental Supervision 1:18-22. However, the responsibility may also be withdrawn to the initially responsible authority if the conditions stated in the Ordinance on Environmental Supervision 1:20 are not fulfilled (the Ordinance on Environmental Supervision 1:21). In cases where the responsibility has been transferred from a County Administrative Board to a municipal committee, a regulatory agency may also withdraw the responsibility (the Ordinance on Environmental Supervision 1:22).

## 3.2 Questionnaire study

### 3.2.1 Demographic data

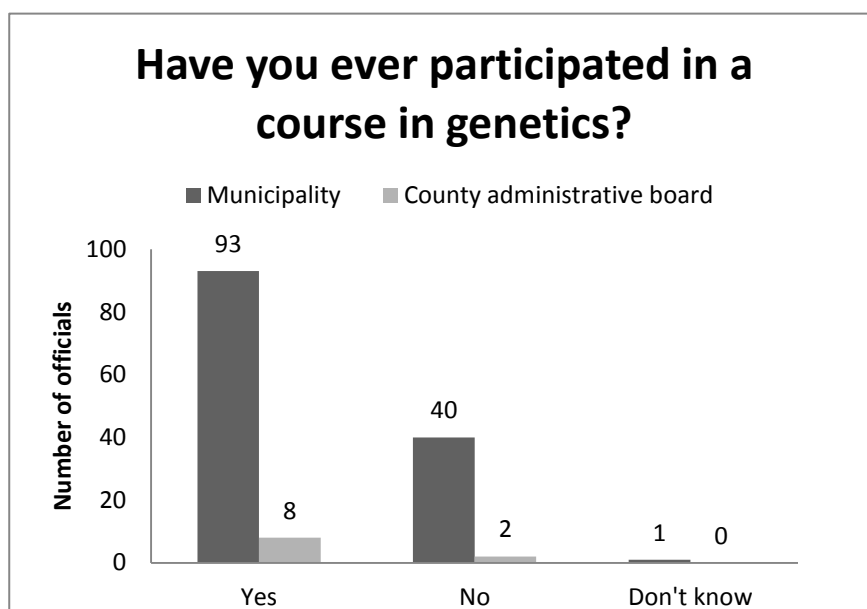
In total 147 officials participated in the questionnaire survey, out of these, 137 were employees at the municipal level, whereas 10 were employed at a County Administrative Board. This means that at both governmental levels, the answering

frequency was about 50% with 137 out of 274 answers from the municipal level and ten out of 21 from the County Administrative Boards.

Genders were evenly distributed between the two groups ( $p: 0.411$ , Fisher's Exact test), with a total of 79 men and 69 females participating from both groups. At the municipal level, 72 men and 65 females participated in the survey, from the County Administrative Boards, four men and six females participated.

### 3.2.2 Genetic knowledge

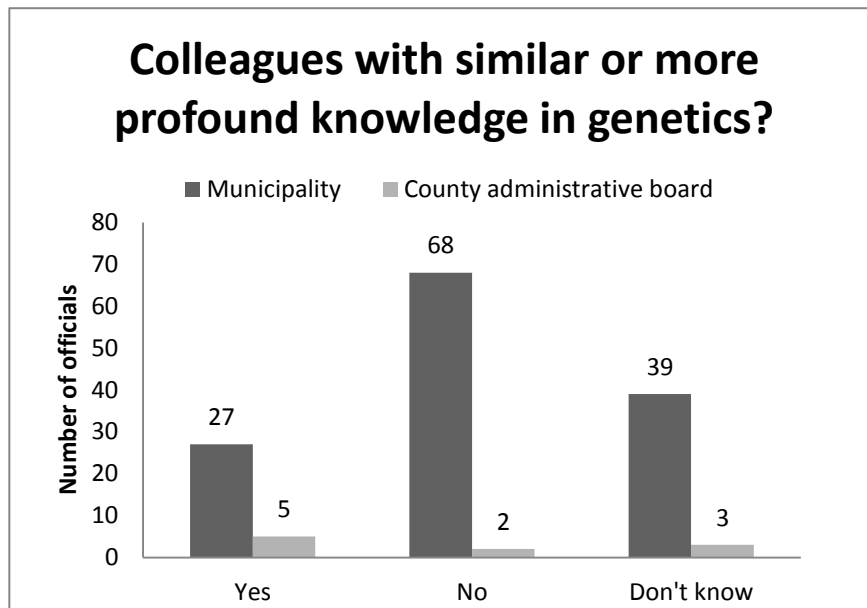
As for the level of education in genetics, a majority (69.4 and 80% respectively) of the officials at both the Municipalities and the County Administrative Boards had participated in a course which specifically addressed population genetics. A Fisher's Exact test revealed no differences in the level of education between the two groups ( $p: 0.53269$ ). The distributions of officials that had participated in a course in genetics are depicted in figure 1.



Figur 1. Number of officials that have participated in a course in genetics divided by place of work.

Officials at the County Administrative Boards more often had at least one colleague with similar knowledge in genetics as themselves. A majority (50.7%) of the officials at the Municipalities did not have any colleague with a similar or more profound knowledge in genetics as themselves, 20.1% did have a colleague with similar knowledge in genetics and 29.1% did not know if their colleagues had that type of knowledge or not. At the level of County Administrative Boards, five

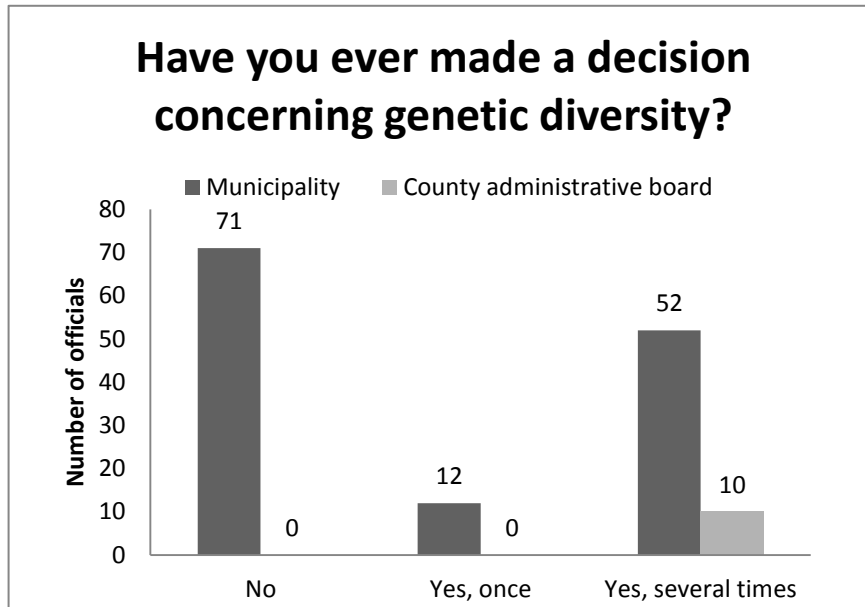
out of ten officials replied that they had colleagues with the same type of knowledge in genetics as themselves whereas two did not and three was not sure. A Fisher's exact test revealed that these differences were near significant at  $p=0.0587$ . In the commentary section of the questionnaire, several officials at the Municipality level have mentioned that they are rather alone in their work with nature conservation and lack colleagues to discuss these issues with. Figure 2 illustrates this.



Figur 2. Answers to the question: "Does any of your colleagues at your current work place have a similar or more profound knowledge in population genetics as yourself?" Differences between the two groups of officials are near significant at  $p=0.0587$  (Fisher's Exact test).

### 3.2.3 Work with genetic diversity

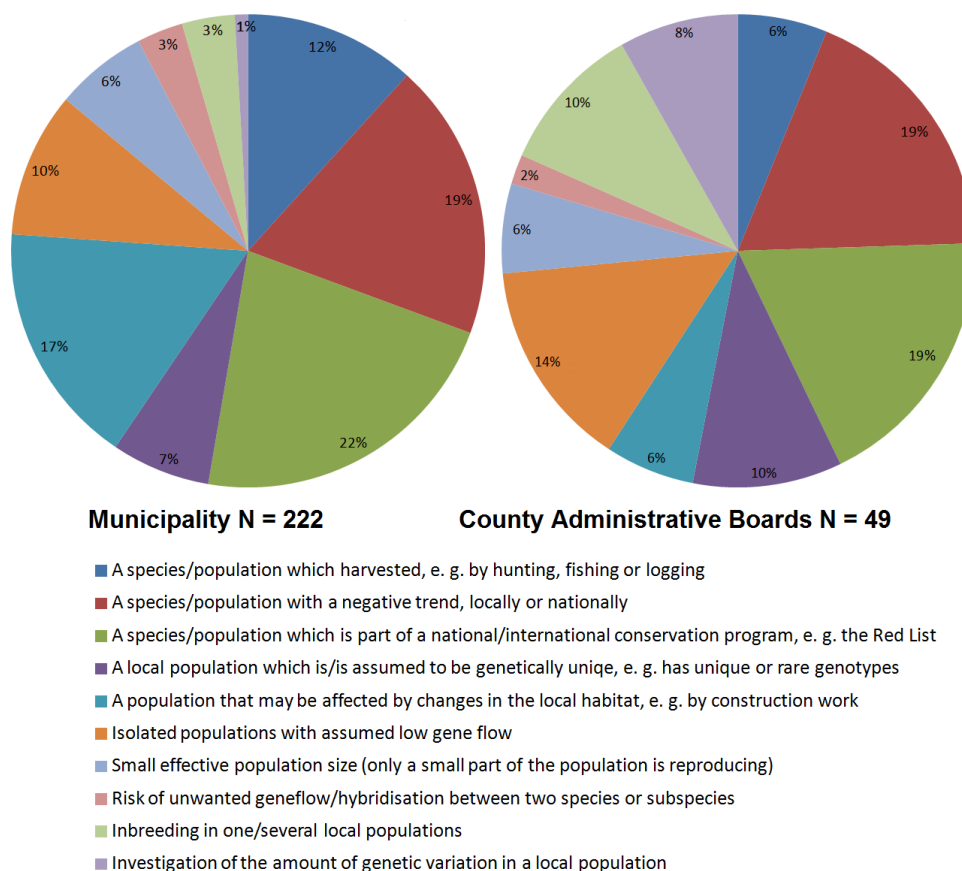
All officials at County Administrative Boards had made decisions that concerned genetics more than once. At the municipal level, 52,6% of the officials had never made decisions that concerned genetics, 8,9% had done it once and 38,5% had made decisions in genetics more than once. The differences in tendency to make decisions that concerned genetics was significant at  $p=0.000576$ . Figure 3 illustrates the differences between the two groups in terms of tendency to make decisions in genetics.



Figur 3. Answers to the question: "Have you ever had to make a decision concerning the need to monitor and/or protect genetic diversity at your current place of work?" Differences between the two groups of officials are significant at  $p=0.000576$  (Fisher's Exact test).

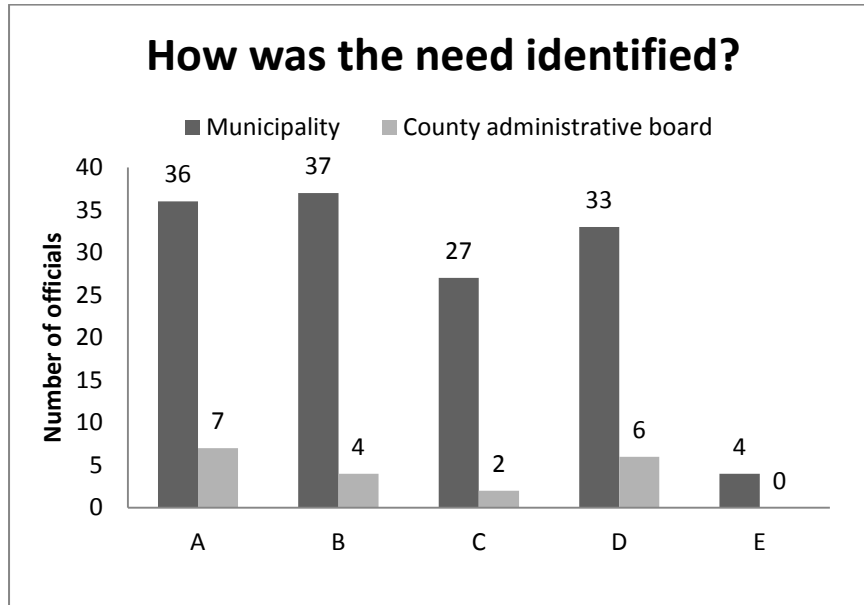
The decisions concerning the need to monitor and/or protect genetic diversity concerned several different fields of genetics and varied between the two groups of officials. At the Municipalities, officials did more often consider species/populations that are harvested or affected by changes in their habitat, such as construction work than officials at County Administrative Boards did (17 vs. 6%). On the other hand, 10% of the officials at County Administrative Boards had considered inbred populations, compared to 3% of the officials at the Municipalities. Figure 4 illustrates the decisions divided between the two groups of officials.

### What did the decision concern?



Figur 4. Decisions including genetic aspects made by officials at the two governmental levels listed below the figures and marked in different colors. The sizes of the pie charts indicate the relative amounts of officials that had made one or several decisions of that kind. Several options were possible to indicate in the survey.

The officials at County Administrative Boards most often identified the need to monitor and/or protect genetic diversity within their organization or by the fact that the general status of the species indicated a need for monitoring. Officials at the Municipalities also often identified the need within the organization or from the general status of the species, but were also much more likely to receive the information from someone outside the organization, either from someone who identified in his/her profession, or from a person who had identified it during a non-profit work or hobby. Figure 5 illustrate this.



Figur 5. Illustration of how the need to monitor and/or protect genetic diversity was identified at the two governmental levels. Several options were possible. A: I/my colleague identified the need. B: A person outside my organization identified the need as a part of his/her professional duty e.g. during an environmental impact assessment. C: A person outside my organization identified the need during non-profit work or as a part of his/her hobby. D: The general status of the species concerned is considered to call for monitoring/conservation. E: Other.

### 3.2.4 Species

The species that were mentioned as having been discussed in terms of genetic conservation differed between the two groups of participants, 11 species were mentioned by employees at County Administrative Boards and 48 by employees at municipalities. In total, 56 species were mentioned in the study. Only three species were mentioned by both groups, these species were the Clouded Apollo (*Parnassius mnemosyne*), the Hermit Beetle (*Osmoderma eremita*) and the Spring Pasque Flower (*Pulsatilla vernalis*). The species mentioned most often was the Great Crested Newt (*Triturus cristatus*), the Freshwater Pearl Mussel (*Margaritifera margaritifera*) and the Hermit Beetle (*Osmoderma eremita*), which were all mentioned by five different officials. In the cases of the mussel and the newt, all officials that had worked with them were employed at the municipal level.

All species, except one, that was mentioned by employees at County Administrative Boards are both on the Swedish Red List and in the program for Action Plans for Threatened species. In contrast, employees at the Municipality level mentioned 17 species that are only protected by the Red List, 3 species that have an Action Plan but are currently not Red Listed, and 22 species that are both Red Listed and

have an Action Plan. A summary of the number of species from each red list category that were mentioned in the survey can be found in table 1. In table 2, the numbers of species which have Action Plans and were mentioned by officials from each group are listed, along with the percentage of the 400 species that have an action plan, which were covered in this survey.

*Tabell 1. Summary of species from each red list category. ( RE: Regionally Extinct, CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, DD: Data Deficient)*

Red List Status	County Administrative Board	Municipality
Not listed	0	9
NT	2	12
VU	1	11
EN	5	13
CR	2	3
RE	0	0
DD	1	0
Total	11	48

*Tabell 2. Summary of numbers of species with and without Action Plans and the percentage of species with Action Plans covered by the study mentioned by officials as County Administrative Boards and Municipalities, respectively*

Action Plan	County Administrative Board	Municipality
Yes	10	25
No	1	23
Total	11	54
% of total species with Action Plans	2,5	6,25

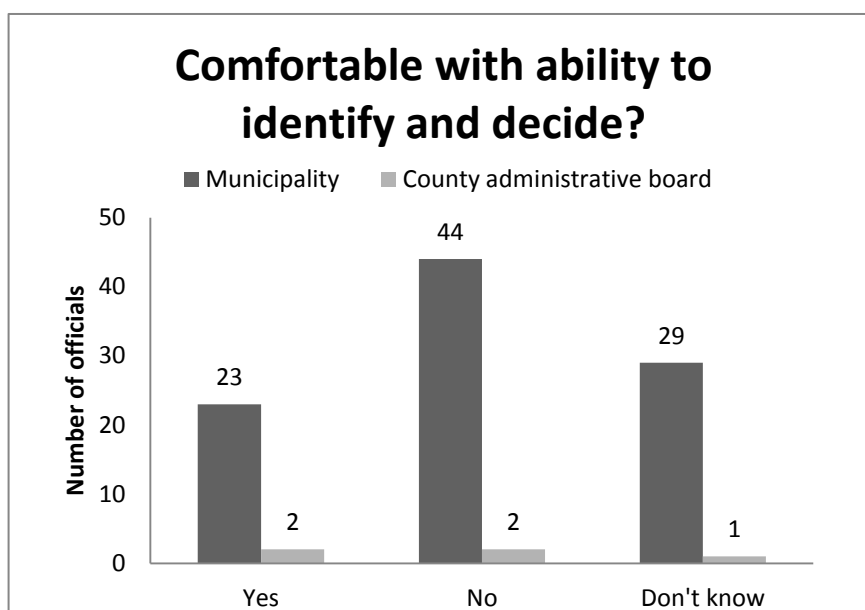
Interestingly, six of the species that had been discussed in terms of genetic considerations at Swedish Municipalities were neither on the Swedish Red List, nor in the program for the Swedish Action Plans for Threatened species. This means that 10.7 % of the species mentioned by officials participating in the questionnaire survey do not benefit from any form of strict legislative protection in Sweden.

In Appendix 4, all the 56 species that were mentioned in the survey are listed with Swedish and English trivial names, scientific names, the number of times the species was mentioned in the survey, and where the official who mentioned it was working. Appendix 4 also contains information on whether the species is part of

the Swedish Action Plans for Threatened species, and if it is currently on the Swedish Red List.

### 3.2.5 Situation at work place

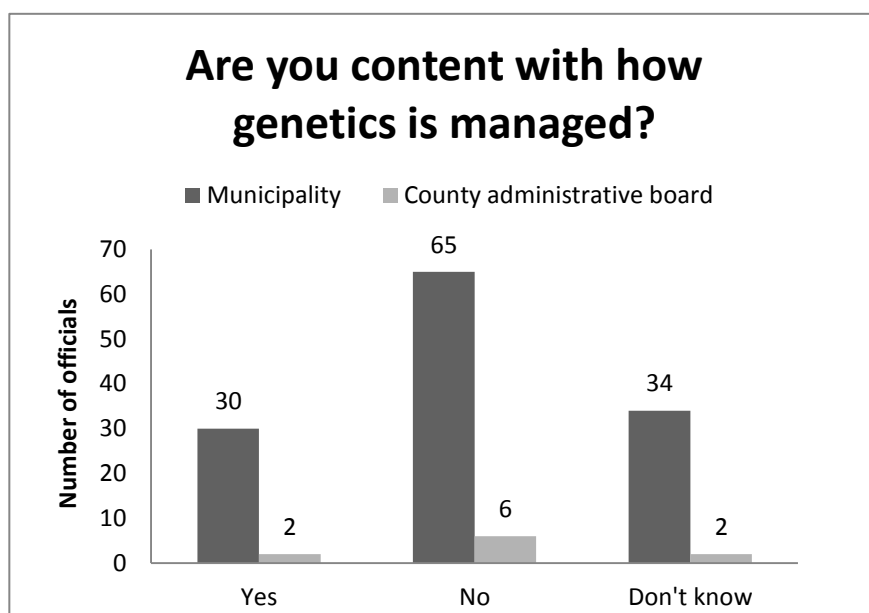
At both governmental levels, many officials were not comfortable with their own or their colleagues ability to identify and make decisions in matters concerning genetic diversity. At the municipal level, 24% answered that they were comfortable with their ability to make decisions related to genetic diversity, whereas 45,8% were not and 30,2% were not sure. At the County Administrative Boards, two out of five officials were comfortable with their ability to make decisions in genetics, two were not, and one was not sure. Neither of the two officials that were comfortable with their ability to identify such situations had participated in a course in genetics. There were no significant differences between the two groups of officials in terms of how comfortable they were with their ability to make decisions in genetics. The results from this question are illustrated in figure 6.



Figur 6. Answers to the question "Are you comfortable with your own/your colleagues ability to identify and make decisions in matters concerning genetic diversity?"

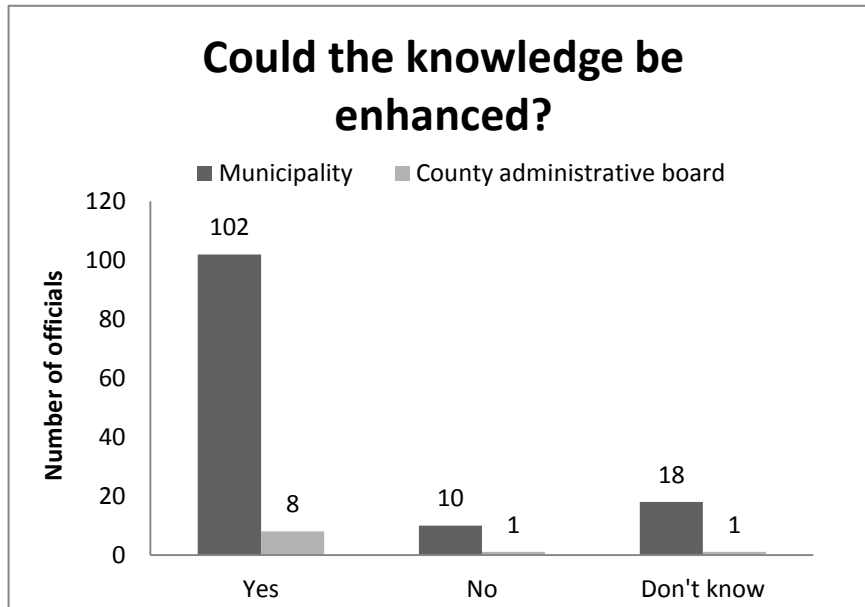
At both governmental levels, most officials were not content with how genetics was managed at their place of work. At the municipal level, 50.4% were discontent, 23.3% were content and 26.4% were unsure. Six out of ten officials at the

County Administrative Boards replied that they were discontent, two were content and two were unsure. These trends are illustrated in figure 7.



Figur 7. Answers to the question "Are you content with how questions concerning genetics are managed at your place of work?"

A majority of the officials at both levels of government thought that the knowledge about genetic issues could be enhanced at their work place. Eight out of ten officials at the County Administrative Boards and 78.5% of the officials at the municipalities thought that the knowledge about genetic issues could be enhanced at their work place. Their answers are illustrated in figure 8.



Figur 8. Answers to the question if the knowledge in genetics could be enhanced at the work place.

## 4 Discussion

In this thesis work, a questionnaire study was performed among officials working with nature conservation at Swedish County Administrative Boards and Municipalities. The aim of the study was to investigate if and how officials at these governmental institutions work with conserving genetic diversity. A literature review was also performed, with the aim of investigating how genetic diversity is protected in the Swedish legislation. In this section, the results from the questionnaire study will be discussed in relation to the legislative obligations of the two governmental institutions.

### 4.1.1 Are officials working with genetics?

As expected, all officials at County Administrative Boards had made decisions about the need to monitor and/or conserve genetic diversity, while most officials at the Municipalities had not been in a situation where they had to make such a decision. I expected that this situation would be a consequence of the legislative obligations of the County Administrative Boards, but there may be several other reasons for the tendency of officials at County Administrative Boards to work with genetic issues more often than officials at the municipal level. For example, there may be differences in amount of time available for this type of work between the two groups of officials. The selection of target groups may also have influenced the results. Although demographic and educational factors such as gender and level of education in genetics did not differ between the two groups, the mere process of how they were selected to participate in the study did differ.

As the two governmental institutions that participated in the study are structured in different ways, the selection of officials that were invited to participate in the study had to be performed in two different ways, which may, to some extent, have influenced the outcome of the study. At the level of County Administrative Boards, the contact person on the page for Action Plans for Threatened species at

the homepage was asked to participate in the questionnaire study. At the level of Municipalities, employees working with nature conservation or environment were asked to participate in the study, but if no such person could be found via the homepage of the municipality in question, an employee working with more general environmental issues was contacted and asked to participate. This difference in how the target groups were selected was inevitable as the County Administrative Boards and Municipalities are structured quite differently in Sweden. Nevertheless, this difference could also be reflected in the results found in the study, as participants from the County Administrative Boards may be working more specifically with nature conservation in general and protection of rare species in particular.

The questionnaire study also revealed that officials at County Administrative Boards tend to have more colleagues with similar knowledge about genetics as themselves, whereas officials working with nature conservation at the Municipalities tend to be more isolated in their work. This difference may influence the work performed at the two institutions, not the least by limiting the time and resources available for each employee to consider questions concerning genetic resources.

#### 4.1.2 Type of genetic resources

The types of genetic resources that have been considered by the officials vary a bit between the two levels of governance. For example, the results indicate that officials at Municipalities more often had considered species/populations that are harvested or that are affected by changes in their habitat, such as construction work. At the County Administrative Boards on the other hand, officials had more often considered isolated or inbred populations and were more likely to investigate the amount of genetic variation in a local population. These trends are in line with what was expected as officials at County Administrative Boards are working with species that have an action plan, whereas officials at the Municipality level tend to work on a variety of tasks, including planning and Environmental Impact Assessments.

The study revealed no difference between the groups in terms of how genetic resources that need conservation measures were identified. However, there appeared to be a trend indicating that the Municipalities more often obtain such information from the general public. This may be an effect of the scale hierarchy of the Swedish governmental system, which may simply make it more logic for the general public to contact the local Municipality if he/she finds something interest-

ing/rare in the nature, than to contact the County Administrative Board in the region.

#### 4.1.3 Species

The species that have been taken into consideration due to their genetics also varied between the two levels of government. At the municipal level, both species that are protected by the Red List or an Action Plan and species that are not protected at all were mentioned. At the County Administrative Boards, on the other hand, all species that were mentioned are legally protected. This difference was also expected, as the Municipalities work on a more local scale than County Administrative Boards, which may cause them to notice small changes in the local environment and/or populations of species at an earlier stage the County Administrative Boards do. However, the findings also raise questions regarding the priorities in the work with genetic conservation in Sweden. In most cases, the County Administrative Boards have the national responsibility for the Action Plans (the Environmental Protection Agency, List of Action Plans in production), so naturally the main part of their work should involve such species. In addition, the officials that represented the County Administrative Boards in the survey were selected from people working specifically with the Action Plans for Threatened Species, which further indicates that these officials should have been working with species that have Action Plans.

##### *Commonly mentioned species*

Out of all the species mentioned in the survey, three were mentioned as much as five times. These species had a few things in common; they all have action plans and are all associated with habitats that are also threatened. The Hermit Beetle (*Osmoderma eremita*) is a rare beetle associated with the species rich but increasingly rare habitat provided by old oaks in the open landscape (Antonsson (ed.), 2001). This species is strongly protected and is both Red Listed and has an Action Plan. Thus, it is not so strange that officials in both target groups have been working with this species.

The Great Crested Newt (*Triturus cristatus*) and the Fresh Water Pearl Mussel (*Margaritifera margaritifera*) are the other two species that were mentioned most often in the survey. Just like the Hermit Beetle, these two species have Action Plans and are thus rather strictly protected. Despite having the same level of protection as the Hermit Beetle, these two species were only mentioned by officials at

the municipal level. This difference may be due to a combination of the type of habitat that the species prefer and the differences in the responsibilities between the Municipalities and the County Administrative Boards. The officials from the County Administrative Boards which participated in the survey are working with the protection of species per se, whereas the work at the Municipalities can have a broader approach and concern any species which officials come across in their work. In accordance with the legislative obligations of the Municipalities, much of the work at this level of governance involves construction projects covered by the Planning and Building Act, so officials at the municipalities may often come across species that are threatened by construction projects.

The Great Crested Newt is a species that is strongly associated with the less and less common “pondscapes”; open grasslands with patches of forests and small, preferably fish free ponds (Malmgren, 2007). Such landscapes are often a matter for construction projects, which may explain why it is only mentioned by officials at the Municipalities; these officials may simply be more likely to come across the species in relation to development of municipal comprehensive plans and Environmental Impact Assessments. In fact, in the Action Plan for the Newt, it is specifically stated that it may often be more natural for Municipalities than County Administrative Boards to come across this species (Malmgren, 2007).

As for the Fresh Water Pearl Mussel, its status is threatened from many different factors, such as forestry, decreasing water quality and hydroelectric power stations. The latter mainly influence the populations of mussels by decreasing the populations of trout (*Salmo trutta*) and salmon (*Salmo salar*), two species that serve as host for the mussels larvae and play an important role in its development (Schreiber et al, 2005). These human activities mentioned above are often related to the work performed at the municipalities, which may be the reason why the endangered mussel has also been discussed at this level. In addition, the Action Plan for the species explicitly states that some of the work with protecting the Fresh Water Pearl Mussel will be performed at the municipal level (Schreiber et al, 2005).

#### *Species that are not formally protected*

At the municipal level, several officials also mentioned that they had taken the genetics of more common and (at least not yet) endangered species into consideration. It may be argued that these types of considerations are not needed for species that are not threatened. However, one may also argue the contrary; that such species indeed should be taken into account in the conservation work at the different

governmental levels in Sweden, not the least in the current situation where biological systems all over the world are undergoing great changes. If officials working with conservation are familiar with the status also of the species that are not formally protected, it is plausible that any ongoing changes could be detected at a very early stage. Of course, rare species are still in the most urgent need of conservation measures, and with a limited budget, these species do need to be prioritized. Yet, I want to argue that the local knowledge of populations and species which are not rare or threatened is very important, both when trying to identify changes, and when trying to gain public support of the conservation work. The common, not yet threatened but easily seen and recognized species, might even prove valuable as “flagship species” for their local habitat. At the Municipalities, this protection of more common species may prove extra valuable as the Municipalities have a more executive role in Swedish land management and work on a more local scale than County Administrative Boards (Hahn et al, 2006), a fact which may enable them to notice (and prevent with) small changes in the local environment at an early stage.

#### 4.1.4 Situation at work place

The questionnaire survey revealed the alarming situation that most officials at both levels of governance were neither comfortable with their own nor their colleagues ability to identify matters of concern that are related to genetic diversity. In addition, most officials were also discontent with how question concerning genetics are managed at their place of work. One possibility is that that this is an effect of officials being rather well educated in the field of genetics, but are suffering from the Dunning-Kruger effect, which causes the level of confidence to decrease with the level of knowledge in a certain field, and vice versa (Kruger, 1999). Since officials at both governmental levels are rather well educated in the field of genetics, they might also be more aware of the flaws in their work and mainly see the parts of it that need improvement.

However, as officials also suggest that their knowledge concerning genetics could be enhanced, the Dunning-Kruger effect is probably not the sole reason for this problem, as officials with little knowledge then would overestimate their own abilities and not want to learn more about the conservation of genetic diversity.

#### 4.1.5 Legislative obligations to conserve genetics

Apart from the questionnaire study, this thesis work included a literature review of the obligations for Municipalities and County Administrative Boards to conserve

genetics. In the work with the literature review, a few things came clear; first, very few parts of the Swedish national legislation explicitly state anything about genetics but that several sections cover the topic in a less direct way. Second, the evaluations available of the work with for example the fulfillment of the obligations in the CBD indicate that even less is done in practice.

The Swedish work with the CBD has been evaluated by the Swedish Environmental Protection Agency in four National Reports, in 1998, 2001, 2005 and 2009 (<http://www.cbd.int/reports/search/>). In the most recent Swedish National Report, it was concluded that the interim target *Halting the loss of biodiversity* (Ministry of the Environment, 2009), would probably not be fulfilled within the given time-frame, i. e. before 2010. This was concluded as nearly three out of four natural habitat types, and around half of the species targeted did not, at the time of the study, enjoy a favorable conservation status. Also, the species on the Swedish Red List were still declining, as were several previously common species (Ministry of the Environment, 2009). In this thesis work, nothing has been found that would indicate that these trends have been halted, at least not if the value of how content officials are with the work performed at their current work place can be used as a measure of how the work is going.

As for the genetic aspects of biodiversity, the National report (Ministry of the Environment, 2009) merely concluded that the work to halt the losses had only recently begun, and that Swedish conservation work was focusing on species rich biotopes and substrates, whereas other aspects of biodiversity were less well known, including the levels of species and genetics (Ministry of the Environment, 2009). This, too, is a situation that still appears to persist, despite the fact that the Ministry of the Environment (2009) did recognize that the Environmental Quality Objective A Rich Diversity of Plant and Animal Life is based on the CBD and its levels of landscapes, species and genetics.

Finally, the Ministry of the Environment (2009) concluded that the CBD goal of promoting the conservation of genetic diversity of the wild fauna and flora in Sweden by 2010 will only partially be met. The main reasons for this was that the plans for an assessment and monitoring program would not be operational by 2010, and that even basic knowledge about genetic diversity was still limited in most taxonomic groups. Despite all this, it was concluded in the report that the most severe obstacles preventing the fulfillment of the CBD goal of conservation of genetic diversity in Sweden was the low level of recognition of this goal among decision-makers, and the lack of funding (Ministry of the Environment, 2009). This was concluded despite that the questionnaire study from 2006 found that little

is done to conserve genetic diversity, despite a high level of recognition among decision makers (Environmental Protection Agency, 2006).

Nevertheless, it is clear that the Environmental Objectives are, and should be, integrated into the work at the Municipalities and County Administrative Boards. At all levels of governance, the Objectives should be adjusted to integrate the environmental objectives into the rest of the work performed, that is, in planning, development of green areas, and as a part of the work with the Swedish Environmental Code and the Swedish Planning and Building Act (Miljö- och samhällsbyggnadsdepartementet, 2005). Such an integration of the objectives into other fields could be give adequate attention to the Environmental Objectives in general and the Objective on Biodiversity and genetic diversity in particular.

Lately, the Environmental Protection Agency (2012) has detected a potentially positive trend in the work with the environmental goals at the Swedish municipalities. In their annual report on the work with the environmental objective, it was suggested that even though the general public often has a very limited knowledge about biological diversity, the political interest in these matters has increased as a result of financial investments.

#### 4.1.6 Methodology

The methods used in this study could be improved in several ways. In this section, the methodology used is discussed in terms of pros, cons and potential for improvements.

##### *Uneven sample sizes*

Already when designing the study, it was clear that the sample sizes between the two target groups would be rather uneven. This was expected as a consequence of the number of Municipalities found in Sweden is so much higher than the number of County Administrative Boards (290 compared to 21). In the end, sample sizes were indeed very uneven, as 137 officials at the Municipal level and ten from the County Administrative Boards participated in the study. This uneven sample size did of course influence how the data could be analyzed (see section on statistics).

There are several ways in which these uneven sample sizes could have been avoided; however, all of these come with drawbacks. One solution could have been to randomly sample 21 Municipalities from the 290, thus asking equally large groups to participate. However, this could still have led to unequal groups as there was no guarantee that any answers at all would appear. Furthermore, such sampling would most likely have been skewed, as any map of the country can re-

veal that there are more and smaller Municipalities in the south than in the north. Thus, a randomly drawn Municipality would be more likely to be located in the south than in the north, and a study based on such randomly drawn samples would risk to not fully cover the situation in the country as a whole.

Another way to avoid the risk of uneven sample sizes would have been to randomly pick one Municipality from each County. However, this would still involve the risk of uneven sample sizes, as it was impossible to know how many answers the study would result in.

Thus, one official from each Municipality was invited to participate in the survey. Primarily because of the risk of not getting enough answers, but also because the situation where little was known about what type of work was really performed at this level and all information had to be thought of as interesting information. In the cases when several Municipalities collaborate in their environmental work and only had one office and one contact person, only one person was invited to participate in the survey. This was done in order to avoid pseudo replication.

#### *Contact information*

No official or easily accessed lists of e-mail addresses to suitable contact persons at the two levels of governance were available when the survey should be distributed. Therefore, as described in the methods section above, contact information had to be searched for at the web pages of the Municipalities and County Administrative Boards. This method of searching for information was not ideal, as there was a risk that the “wrong” person would be asked to participate in the survey. An alternative might have been to contact all Municipalities and County Administrative Boards before sending out the invitation, and ask for a specific contact person. However, that would have come with the risk of having to wait for 290 plus 21 answered e-mails, many of which might have never been answered at all.

#### *Answering frequencies*

Another factor that deserves to be discussed is the answering frequencies in the study. In both groups, around half of the officials asked to participate did so. As the survey was non-mandatory and not a part of their daily work, this can be regarded as a rather high number, as filling it in would have been something they did “outside” their normal duties. On the other hand, this also means that all results in this study are based on a subsample of the total group of officials asked to participate. The subsample must be regarded as nonrandom since we cannot exclude the

risk that the persons that choose to participate in the survey are more similar to each other than to the people that choose to not participate.

It is not unlikely that the people that choose to participate in a survey concerning genetics are those that in some way feel connected to the subject, either because it is a part of their education or because they are confronted with the issues in their daily work. Thus, it may be wise to regard the results from this study as “overly positive” in the sense that the people that have participated are the ones that know the most about genetics and/or work with it the most. Of course, the ones that are unhappy with how the work is performed would also be more likely to participate, but in order to be able to be unhappy about something, you need to have enough skills to be able identify the problem. In other words, there is a risk that this study reveals a brighter picture of the amount of work and the level of competence in genetics that is available at Swedish County Administrative Boards and Municipalities. Consequentially, it is probably wise to consider all numbers presented in this study as representing the “best case scenario”. In reality, the situation might be worse.

In conclusion, the only way to avoid the problems caused by officials choosing not to answer would have been to make a survey like this mandatory, e.g. by asking the Environmental Protection Agency to distribute it. However, the risk would then be that officials may be tempted to depict a slightly brighter picture than what is really the case, which may be worse than the opposite scenario.

### *The SLU Survey Generator*

One major issue with the whole questionnaire survey was the survey generator selected. In its original design, the survey was meant to control the way officials could answer questions, so that if they had answered “no” on question A, they should not be able to answer any subsequent question that was directed towards those who had answered “yes” on question A. This, however, was one of the technical functions of the SLU Survey Generator which were out of order.

Another thing that did not work as it should was the function of making certain questions mandatory. Since this function did not work, the answering frequencies came to vary greatly between different questions, making it difficult to analyze them statistically.

### *Statistics*

For the practical and technical reasons stated above, the questionnaire turned out to be hard to analyze statistically. One issue was that sample sizes were so uneven

that parametric tests were out of the question. In addition, due to a combination of technical problems with the survey generator and some questions being less well-reasoned, it was hard to find tests that were applicable on the data at hand.

In the end, the Fisher's Exact test was selected, as it was considered to be the most applicable test for the task. However, the results from the Fisher's Exact test will only tell if the data observed differs from the values expected in the null hypothesis. Thus, in reality, the test might not provide more information than the mere percentage values obtained in the study in the first place do. If the study was to be performed again, it would definitely be preferable with a study design that was easier to analyze statistically. On the other hand, the study design used did provide a lot of valuable information, which might not have been obtained if the statistical analysis had been the main goal.

#### 4.1.7 Potential for further studies

Several questions have been raised during the process of working with this thesis. There is a lot of potential to further develop the study, by for example inviting other groups of officials to participate, to ask more questions, and to analyze the results even further.

First, it would be interesting to invite an even larger group of people to participate in the study. Given how the Swedish system of governance is built up, it would at least be interesting to also invite the politicians that are working with environmental issues and the officials at the two largest official agencies working with nature conservation and use of natural resources, i.e. the Environmental Protection Agency and the Swedish Agency for Marine and Water Management. By incorporating these levels of governance, it might be possible to get a more comprehensive picture of the work with conserving genetic diversity in Sweden. In addition, this approach could then be one step towards mapping out and describing the entire line of action associated with conservation of genetic diversity, from international legislations to local applications at the Municipalities.

Furthermore, it would be valuable to ask more questions, and to make them more specific. This could be done in several ways, either by using a more complex and technically functional survey generator, or by instead designing a study based on interviews. The first approach would have more potential in terms of statistical analysis and be more time and cost efficient, whereas the second might provide more valuable information since there would be more room for personal reflections.

Finally, the data from the questionnaire survey contains a lot more information than what could be analyzed in this thesis work. Several of the questions in the survey deserve to be analyzed, both one and one and in comparison with other answers. In addition, it would be of great interest to summarize the annotations written in the commentary fields, as these are full of valuable reflections on the work performed at the two levels of governance.

#### 4.1.8 Proposal for a National Centre for Conservation of Genetics

This study is the first one to have explored the work related to conserving genetic diversity at the two levels of governance in Sweden where most of the “hands on” work with nature conservation is performed. At the County Administrative Boards, officials are working more or less directly with nature conservation, either at the species level through e. g. Action Plans, or at the landscape level with planning and managing nature reserves. The work with genetics performed at this level has been studied before, but mainly in terms of an inventory of the knowledge available. Here, focus was on the actual work performed.

At the Municipal level, officials often work alone and with matters closely related to planning and building, a work which may strongly influence populations of species that are present in the targeted area and thus also the genetics of these species. The work with genetics performed at the Municipal level has not previously been studied, neither in terms of the level of education of the officials, nor in terms of the work performed. Thus, the results from this study are important in targeting a new way to look at the conservation work correlated with genetics which is performed at Swedish Municipalities and County Administrative Boards.

The study may therefore be considered as a first step towards raising the awareness of the importance of conserving genetics at all levels of governance, and to acknowledge the differences in the work performed at these different levels, so that the work can benefit from the strengths of each level and weak points can be strengthened. For example, this study found that officials at the Municipal level very often work alone and lack colleagues with sufficient knowledge to discuss the issues at hand. Knowing this, intends to improve the conservation work performed at the Municipal level may take the lack of colleagues into account. Perhaps, officials at the Municipalities would benefit from an enhanced formal or informal collaboration across municipal borders. Or maybe the colleagues of these officials could participate in some sort of in-job training and gain more knowledge.

Another way to target the issue of officials working alone could be to create a national center to which officials at all levels of government could turn with their

questions that are related to genetics. This thought was presented already after the study in 2006, which suggested that a secretariat for population genetic issues should be established in order to reduce the gap between knowledge and practice described found then. To this date, no such secretariat has been established, and the situation at the Municipal level found in this thesis work can indeed be considered a call for such a center.

In the study from 2006, the Swedish Environmental Protection Agency suggested that a secretariat for population genetic issues was to be established at the Swedish Biodiversity Centre (Environmental Protection Agency, 2006). However, in 2012, no such center had been established, and the results from the questionnaire survey performed as a part of this thesis work do indicate that the work to ensure that genetic variation is kept at a sufficient level in wild populations of plants and animals in Sweden remains insufficient.

This view is supported by the fact that even though signs of improvements have been detected recently, the officials that participated in the questionnaire survey performed in this thesis are not content with how the work with conserving genetic diversity is performed at their current place of work. Furthermore, officials at both governmental levels believe that the level of genetic knowledge could be enhanced. It is indeed alarming that so many officials are discontent and uncomfortable with the work they perform. Not the least as previous studies have revealed a similar situation.

The national annual report for 2012 on the work with the Swedish Environmental Objectives concluded that the lack of genetic knowledge obstructs the work with the environmental objectives, not only in terms of the fulfillment of the objectives, but also when it comes to the predictions of how far we are from fulfilling the objectives (Environmental Protection Agency, 2012). One of the measures called for in this report is a national action program for the conservation of genetic variation in wild plants, animals and fungi. This goes well in line with the results from this thesis work, where officials have stated that they are not satisfied with the work they perform and believe that it could be enhanced.

Many officials at the municipal level also lack colleagues with similar knowledge to discuss issues concerning genetics with. These two factors combined can be interpreted as a strong call for a national center for counseling in genetic conservation similar to the secretariat suggested by the Environmental Protection Agency (2006). If such a center existed, and if officials at all governmental levels were able to contact it and get advice concerning conservation of genetic diversity, this might solve several of the matters contact in order to discuss matters

concerning genetics. Apart from giving advice to officials in need for it, the center could also be responsible for arranging courses to further enhance the knowledge in genetics possessed by officials at all governmental levels, thus further enhancing the ability of officials to make well-grounded decisions in their work with conservation of genetic diversity.

Although the establishment of a secretariat for population genetic issues would be a part of the solution to the problems with governance of genetic resources in Sweden today, a center cannot be the whole solution. Other things are also required, such as more finances directed at nature conservation, both at the level of research and at the governmental level. Furthermore, a deeper understanding of the importance of conservation measures in general and genetics in particular is crucial, not the least among politicians at the municipal level. As the signs of climate change grow increasingly stronger, it is also important to recognize the effect these changes may have on both rare and common species and their genetics. The incorporation of the aspect of genetic diversity into the conservation work performed at Swedish Municipalities and County Administrative Boards is an important task, but also one that will require time and resources. As threats towards species and their habitats increase, time is getting scarce, causing an ever greater need for more resources directed at the work with conserving genetic diversity.

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## Online

CBD official web site, with search engine to find national reports

(<http://www.cbd.int/reports/search/>)

List of Action Plans in production (Produktionslistan över alla åtgärdsprogram)

([http://www.naturvardsverket.se/upload/04\\_arbete\\_med\\_naturvard/Hotade%20arter/N\\_atgardsprogram\\_Rev\\_2010\\_28\\_maj.pdf](http://www.naturvardsverket.se/upload/04_arbete_med_naturvard/Hotade%20arter/N_atgardsprogram_Rev_2010_28_maj.pdf))

## 5 Appendices

### 5.1 Appendix 1: Letter of information to participants in the questionnaire study

Hej,

Du som arbetar med naturvårdsfrågor på en svensk kommun eller länsstyrelse inbjuds att delta i en enkätundersökning som rör arbetet med bevarande av genetisk mångfald på din arbetsplats. Om du inte själv arbetar med naturvårdsfrågor får du väldigt gärna vidarebefordra detta e-mail till en kollega som har sådana arbetsuppgifter.

Undersökningen genomförs som en del av ett examensarbete i biologi vid Sveriges Lantbruksuniversitet. Enkätsvaren kommer att användas som underlag för att utveckla en arbetsmodell för beslutsfattande kring genetiska och evolutionära bevarandestrategier, framförallt vad gäller när genetiska data ska samlas in och hur insamling och analys av dessa ska gå till.

Genom att medverka i denna studie bidrar du till att arbetsmodellen kan utformas på ett så relevant sätt som möjligt, så att den i framtiden kan komma till användning i ditt eller dina kollegors arbete med att bevara biologisk mångfald. Ditt deltagande är med andra ord mycket viktigt!

Svarstiden beräknas till 20 minuter och dina svar är helt anonyma. Du når undersökningen genom att klicka på denna länk: <http://enkater.slu.se/svara.cfm?sv=2594-Gen2012>

Jag ser med stort intresse fram emot dina enkätsvar och svarar gärna på frågor om enkäten, antingen per telefon eller via e-post.

Vänliga hälsningar

Johanna Ehlin

[joeh0001@stud.slu.se](mailto:joeh0001@stud.slu.se)

## 5.2 Appendix 2: Questionnaire survey including all questions

### **Enkätundersökning: Bevarande av genetisk mångfald**

**Beskrivning** Denna enkätundersökning genomförs som en del i ett examensarbete vid Sveriges Lantbruksuniversitet och riktar sig till personer som arbetar med naturvårdsfrågor på Svenska kommuner och länsstyrelser. Undersökningen syftar till att undersöka hur arbetet med att bevara genetisk mångfald och evolutionära processer går till på dessa arbetsplatser, samt att identifiera hur detta arbete skulle kunna förbättras.

Resultaten från undersökningen kommer att utgöra ett underlag för utvecklingen av en arbetsmodell för frågor om genetisk mångfald och evolutionära processer. Målet är att arbetsmodellen skall kunna vara till hjälp när beslut om genetiska och evolutionära bevarandestrategier ska fattas, framförallt i frågor som gäller när genetiska data ska samlas in och hur insamling och analys av dessa ska gå till.

Genom att medverka i denna studie bidrar du till att arbetsmodellen kan utformas på ett så relevant sätt som möjligt, så att den i framtiden kan komma till användning i ditt eller dina kollegors arbete med att bevara biologisk mångfald. Ditt deltagande är med andra ord mycket viktigt!

Svarstiden för denna enkät beräknas till ca 20 minuter. På de flesta frågor är det bara möjligt att välja ett av svarsalternativen, i några (angivna) fall är det möjligt att välja flera alternativ och i ett par frågor ombes du att ranka dina svar enligt en given skala.

Stort tack för din medverkan!

**Ansvarig utgivare** Johanna Ehlin  
joeh0001[at]stud.slu.se

## Demografiska frågor

### \* 1.1 Är du man eller kvinna?

- ☐ Man
- ☐ Kvinna

### \* 1.2 Födelseår

### 1.3 Arbetsort

### \* 1.4 Arbetsgivare

- ☐ Kommun
- ☐ Länsstyrelse

## Utbildning

### \* 2.1 Utbildningsnivå

### \* 2.2 Utbildningens inriktning

### \* 2.3 Examensår från utbildning enligt ovan

Ange årtal med fyra siffror, t ex 1998

## Genetiktkunskaper

### \* 3.1 Har du någon gång gått en kurs med särskild inriktning på populationsgenetisk teori och/eller populationsgenetiska frågeställningar?

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

### 3.2 Om ja, på vilken nivå?

Flera val är möjliga.

- ☐ Grundläggande nivå eller som del i annan kurs på högskola eller universitet
- ☐ Påbyggnadskurs på högskola eller universitet

- ☐ Fortbildning via min nuvarande arbetsplats
- ☐ Fortbildning via en tidigare arbetsplats
- ☐ Annat

**\* 3.3 Har någon/några av dina kollegor på din nuvarande arbetsplats likvärdiga eller mer djupgående kunskaper i populationsgenetik som du själv?**

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

**3.4 Om ja, hur många?**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ >5

**Arbetsuppgifter**

**\* 4.1 Vilka är dina huvudsakliga arbetsuppgifter på din nuvarande arbetsplats?**

*Flera val är möjliga.*

- ☐ Arbete med översikts- och detaljplaner
- ☐ Besvara remisser
- ☐ Förvalta mark
- ☐ Guidning
- ☐ Handlägga tillsynsärenden

- ☐ Inventeringsarbete
- ☐ Jakt- och fiskefrågor
- ☐ Kartläggning/arbete med GIS
- ☐ Marknadsföring
- ☐ Miljömålsarbete (lokalt/nationellt)
- ☐ Naturreservatshantering
- ☐ Praktiskt naturvårdsarbete i fält
- ☐ Sakkunnig inom miljö- och naturvårdsplaneringen
- ☐ Samarbete med skolor och annan ungdomsverksamhet
- ☐ Skötsel av rekreativa miljöer (t ex vandringsleder)
- ☐ Strandskydds- och bygglovsärenden
- ☐ Upphandlingar
- ☐ Annat

#### \* 4.2 Vilka naturtyper berörs huvudsakligen i ditt arbete?

Ranka alternativen så att 1 är vanligast förekommande, 2 är näst vanligast etc. Naturtyper som inte alls berörs av ditt arbete behöver inte tas med i rankningen.

	1	2	3	4	5	6	7	8	9
Fjäll	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hav	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jordbruksmark	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kustmiljöer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sjöar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skog	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stadsnära natur/parker	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vattendrag	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Våtmarker	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**\* 4.3 Vilka styrdokument använder du direkt i de delar av ditt arbete som relaterar till biologisk mångfald?**

*Flera alternativ är valbara.*

- ☐ Kommunala policydokument med generell inriktning, t ex på samhällsutveckling
- ☐ Kommunala policydokument med specifik inriktning på naturvård
- ☐ Artskyddsförordningen SFS 1998:179
- ☐ De nationella miljömålen (generellt)
- ☐ Det 16:e nationella miljömålet ”Ett rikt växt och djurliv”
- ☐ Föreskrifter från Naturvårdsverket
- ☐ Miljöbalken 1998:808
- ☐ Policydokument från föreningar/intresseorganisationer (t ex Naturskyddsföreningen)
- ☐ Riksdagens proposition om framtidens friluftsliv: Prop. 2009/10:238
- ☐ Åtgärdsprogram för hotade arter och biotoper
- ☐ EU-direktiv kopplade till Natura 2000 (Fågeldirektivet 79/409/EEG & Habitatdirektivet 92/43/EEG)
- ☐ Övriga EU-dokument
- ☐ Bernkonventionen om skydd av europeiska vilda djur och växter samt deras naturliga miljö.
- ☐ Bonnkonventionen om skydd av flyttande vilda djur.
- ☐ Cartagena-protokollet om biosäkerhet och levande modifierade organismer
- ☐ Cites- eller Washingtonkonventionen om internationell handel med utrotningshotade arter av vilda djur och växter
- ☐ Konventionen om biologisk mångfald (CBD/Riokonventionen)
- ☐ Ramsar- eller våtmarkskonventionen om våtmarker av internationell betydelse
- ☐ Valfångstkonventionen
- ☐ Annat

Ditt arbete och genetik

**\* 5.1 Har du någon gång behövt ta ställning till behov av att övervaka och/eller bevara genetisk mångfald i ditt nuvarande arbete?**

- ☐ Nej
- ☐ Ja, en gång
- ☐ Ja, flera gånger

**5.2 Om nej, känner du dig trygg med din/dina kollegors förmåga att identifiera och ta ställning till ett sådant behov om situationen skulle uppkomma?**

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

**5.3 Om ja, vad gällde ställningstagandet?**

*Flera alternativ är valbara. Ange gärna vad som var vanligast i kommentarsfältet.*

- ☐ En art/population som beskattas genom t ex jakt, fiske eller avverkning
- ☐ En art/population som har en negativ populationsutveckling (lokalt eller nationellt)
- ☐ En art/population som är föremål för naturvårdsåtgärder nationellt eller internationellt, t ex genom rödlistan
- ☐ En lokal population som har/antas ha en genetisk särprägel i form av exempelvis unika eller ovanliga genotyper
- ☐ En population som riskerar att påverkas av förändringar i sitt lokala habitat, t ex vid byggarbeten
- ☐ Isolerade populationer mellan vilka genflödet antas vara lågt
- ☐ Liten effektiv populationsstorlek (endast en liten del av populationen reproducerar sig och för sina gener vidare till nästa generation)
- ☐ Risk för oönskat genflöde/hybridisering mellan två arter eller underarter
- ☐ Risk för/förekomst av inavel i en/flera lokala populationer
- ☐ Undersökning av mängden genetisk variation i en lokal population



Endast ett svar är möjligt. Om situationen har uppkommit flera gånger, försök att besvara denna fråga utifrån hur dessa situationer oftast har hanterats.

- ☐ Ja
- ☐ Nej
- ☐ Oftast
- ☐ Nästan aldrig
- ☐ Vet inte

### 5.6 Om nej, varför inte?

Flera val är möjliga, ange gärna den tyngst vägande orsaken i kommentarsfältet.

- ☐ Otillräcklig information om hur en sådan utredning skulle gå till
- ☐ Organisatoriska orsaker (personalomsättning, omstrukturering eller liknande)
- ☐ Ekonomiska begränsningar
- ☐ Tidsbrist
- ☐ Vet inte
- ☐ Annat (ange gärna vad i kommentarsfältet)

Ev kommentar:



### 5.7 Om ja, hur gick ni vidare?

Flera val är möjliga, ange gärna vad som var vanligast i kommentarsfältet.

- ☐ Vi utredde frågan endast internt genom Litteraturstudie/Egna inventeringar/Annat
- ☐ Vi kallade in/tog hjälp av utomstående sakkunnig från Universitet/Konsultfirma/Naturvårdsverket/Artdatabanken/Centrum för Biologisk Mångfald/Annan myndighet/Annat

☐ Annat tillvägagångssätt

☐ Vet inte

Ev kommentar:

### 5.8 Vilket blev resultatet av utredningen?

*Flera val är möjliga. Ange gärna den tyngst vägande slutsatsen i kommentarsfältet.*

☐ Inget behov av övervakning och/eller bevarande av den genetiska mångfalden ansågs föreligga

☐ Det fanns ett behov av att övervaka/bevara den genetiska mångfalden

☐ Frågan bordlades

☐ Annat (ange gärna vad i kommentarsfältet)

☐ Vet inte

Ev kommentar:

### 5.9 Har eventuella föreslagna åtgärder vidtagits?

*Endast ett svar är möjligt. Om situationen har uppkommit flera gånger, försök att besvara denna fråga utifrån hur dessa situationer oftast har hanterats.*

☐ Ja

☐ Nej

☐ Vet inte

Ev kommentar:



### 5.10 Om nej, varför inte?

*Flera val är möjliga. Ange gärna den tyngst vägande orsaken i kommentarsfältet.*

- ☐ Otillräcklig information om vilka åtgärder som behövs
- ☐ Otillräcklig information om hur åtgärder ska genomföras
- ☐ Organisatoriska orsaker (personalomsättning, omstrukturering eller liknande)
- ☐ Ekonomiska begränsningar
- ☐ Tidsbrist
- ☐ Vet inte
- ☐ Annat (ange gärna vad i kommentarsfältet)

Ev kommentar:



### 5.11 Om ja, har åtgärderna följts upp?

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

### \* 5.12 Är du nöjd med hur frågor om övervakning och bevarande av genetisk mångfald hanteras på din arbetsplats?

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

**\* 5.13 Upplever du att kunskapsnivån rörande övervakning och bevarande av genetisk mångfald skulle kunna förstärkas på din arbetsplats?**

- ☐ Ja
- ☐ Nej
- ☐ Vet ej

**5.14 Om ja, inom vilka områden behöver kunskaperna förstärkas?**

*Ranka alternativen så att nr 1 väger tyngst, nr 2 näst tyngst osv. Alternativ som inte känns relevanta behöver inte tas med i rankningen.*

	1	2	3	4	5
Populationsgenetiska grundkoncept, t ex effektiv populationsstorlek, genflöde, hybridisering, inavel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Identifiering av situationer när genetisk mångfald behöver utredas eller övervakas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Val av metoder för att övervaka/bevara genetisk mångfald	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ärendegång vid beslutsfattande och prioriteringar i relation till genetisk mångfald	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Annat (ange gärna vad i kommentarsfältet)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ev kommentar:

**5.15 Övriga kommentarer**



### 5.3 Appendix 3: List of municipalities with common offices for environmental work

Common office	Municipalities
Bergslagens Miljö- och Byggförvaltning	Hällefors kommun Lindesbergs kommun Ljusnarbergs kommun Nora kommun
Bygg- och miljöförvaltningen Sala-Heby	Heby kommun Sala kommun
Dalslands miljökontor	Bengtsfors kommun Dals-Eds kommun Färgelanda kommun Melleruds kommun
Malå/Norsjö miljö och byggavdelning	Malå kommun Norsjö kommun
Miljö- och byggnadsförvaltningen Mariestad, Gullspång och Töreboda	Gullspånga kommun Mariestads kommun Töreboda kommun
Miljö- och byggnämnden för Forshaga och Munkfors	Forshaga kommun Munkfors kommun
Miljöförbundet Blekinge Väst	Karlshamns kommun Olofströms kommun Sölvesborgs kommun
Miljöförvaltningen i Habo och Mullsjö kommuner	Habo kommun Mullsjö kommun
Miljökontoret Mjölby/Boxholm	Boxholms kommun Mjölby kommun
Mora-Orsa Miljönämnd	Mora kommun Orsa kommun
Norrhälsinge miljökontor	Hudiksvalls kommun Nordanstigs kommun
Söderåsens miljöförbund	Bjuvs kommun Klippans kommun Perstorps kommun Svalövs kommun Örkelljunga kommun
Sydnärkes miljöförvaltning	Askersunds kommun Laxå kommun Lekebergs kommun
Västmanland-Dalarna miljö- och byggförvaltning	Avesta kommun Norbergs kommun
Västra Mälardalens Miljöförbund	Arboga kommun Kungsörs kommun

## 5.4 Appendix 4: List of species mentioned in the survey

Including: Scientific names, trivial names in Swedish and English, number of times mentioned in the survey (No), existence of an Action Plan, status on the Swedish Red list (RE: Regionally Extinct, CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, DD: Data Deficient) and the level of governance at which it was found (M: Municipality, C: County Administrative Board).

Group						
Swedish trivial name	Scientific name	English trivial name	No	Action Plan	Red List	Office
<b>Birds</b>						
Berguv	<i>Bubo bubo</i>	Eurasian Eagle-Owl	1	No	NT	M
Fiskgjuse	<i>Pandion haliaetus</i>	Osprey	2	No	-	M
Havsörn	<i>Haliaeetus albicilla</i>	White-tailed eagle	1	Yes	NT	M
Kungsfiskare	<i>Alcedo atthis</i>	Common Kingfisher	1	No	VU	M
Kungsörn	<i>Aquila chrysaetos</i>	Golde Eagle	2	Yes	NT	M
Pilgrimsfalk	<i>Falco peregrinus</i>	Peregrine Falcon	1	Yes	VU	M
Vitryggig hackspett	<i>Dendrocopos leucotos</i>	White-backed Woodpecker	1	Yes	CR	M
<b>Fish</b>						
Asp (fisk)	<i>Aspius aspius</i>	Asp	2	Yes	NT	M
Flodnejonöga	<i>Lampetra fluviatilis</i>	Lamprey	1	No	-	M
Havsnejonöga	<i>Petromyzon marinus</i>	Lamprey	1	Yes	NT	M
Insjööring	<i>Salmo trutta lacustris</i>	Brown trout	2	No	-	M
Lax	<i>Salmo salar</i>	Atlantic salmon	4	Yes	-	M
Vårsiklöja	<i>Coregonus trybomi</i>	Spring-spawning cisco	1	Yes	DD	C
Ål	<i>Anguilla anguilla</i>	European Eel	1	No	CR	M
<b>Frogs and Reptiles</b>						
Grönfläckig padda	<i>Bufo viridis</i>	European green toad	1	Yes	CR	C
Gölgroda	<i>Rana lessonae</i>	Pool Frog	1	Yes	VU	C
Hasselsnok	<i>Coronella austriaca</i>	Smooth Snake	1	No	VU	M
Sandödla	<i>Lacerta agilis</i>	Sand Lizard	2	Yes	VU	M
Strandpadda	<i>Bufo calamita</i>	Natterjack Toad	1	Yes	VU	M
Större vattensalamader	<i>Triturus cristatus</i>	Great Crested Newt	5	Yes	-	M

Åkergröda	<i>Rana arvalis</i>	Moor Frog	1	No	-	M
<b>Mammals</b>						
Barbastell	<i>Barbastella barbastellus</i>	Barbastelle	1	Yes	EN	M
Hasselmus	<i>Muscardinus avellanarius</i>	hazel dormouse	1	No	-	M
Utter	<i>Lutra lutra</i>	European otter	2	Yes	VU	M
Varg	<i>Canis lupus</i>	Gray wolf	1	Yes	EN	M
<b>Insects</b>						
Alkonblåvinge	<i>Maculinea alcon</i>	Alcon Blue	1	Yes	EN	M
Brun gräsfjäril	<i>Coenonympha hero</i>	Scarce Heath	1	No	NT	M
Dågräsfjäril	<i>Lopinga achine</i>	Woodland Brown	1	Yes	NT	C
Grön flodtrollslända	<i>Ophiogomphus cecilia</i>	Green Snaketail	1	No	VU	M
Kronärtsblåvinge	<i>Plebejus argyrognomon</i>	Reverdin's Blue	1	Yes	EN	C
Läderbagge	<i>Osmoderma eremita</i>	Hermit Beetle	5	Yes	NT	M&C
Mnemosynefjäril	<i>Parnassius mnemosyne</i>	Clouded Apollo	3	Yes	EN	M&C
Mulmknäppare	<i>Elater ferrugineus</i>	Red Click Beetle	2	Yes	VU	M
Större ekbock	<i>Cerambyx cerdo</i>	great capricorn beetle	1	Yes	CR	C
Svart guldbagge	<i>Gnorimus variabilis</i>	Gnorimus variabilis	1	Yes	EN	M
Svartfläckig blåvinge	<i>Maculinea arion</i>	Large Blue	1	Yes	NT	M
<b>Invertebrates (except insects)</b>						
Flodkräfta	<i>Astacus astacus</i>	European crayfish	1	Yes	CR	M
Flodpärlmussla	<i>Margaritifera margaritifera</i>	freshwater pearl mussel	5	Yes	EN	M
Tjockskalig målar-mussla	<i>Unio crassus</i>	thick shelled river mussel	1	Yes	EN	M
<b>Mosses</b>						
Barkkvastmossa	<i>Dicranum viride</i>	Dicranum viride	1	Yes	EN	M
Luden bandmossa	<i>Apometzgeria pubescens</i>	Apometzgeria pubescens	1	No	EN	M
<b>Fungus</b>						
Oxtungessvamp	<i>Fistulina hepatica</i>	Beefsteak Fungus	1	No	NT	M
<b>Vascular plants</b>						
Bergviol	<i>Viola collina</i>	Hill Violet	1	No	VU	M

Blåsuga	<i>Ajuga pyramidalis</i>	Pyramidal Bugle	1	No	-	M
Hassel	<i>Corylus avellana</i>	Common Hazel	1	No		M
Klockgentiana	<i>Gentiana pneumonanthe</i>	Marsh Gentian	1	Yes	VU	M
Luddvårlök	<i>Gagea villosa</i>	Field Gagea	1	No	VU	M
Låsbräken	<i>Botrychium lunaria</i>	Common Moonwort	1	No	NT	M
Martorn	<i>Eryngium maritimum</i>	Sea Holly	1	Yes	EN	C
Mosippa	<i>Pulsatilla vernalis</i>	Spring Pasque flower	2	Yes	EN	M&C
Nipsippa	<i>Pulsatilla patens</i>	Eastern pasqueflower	1	Yes	NT	M
Norna	<i>Calypso bulbosa</i>	Fairy slipper	1	No	NT	M
Ryl	<i>Chimaphila umbellata</i>	Winterlieb	2	No	EN	M
Sjönajas	<i>Najas flexilis</i>	Slender Naiad	1	Yes	EN	M
Smalstäkra	<i>Oenanthe lachenalii</i>	Parsley Water-dropwort	1	No	EN	M
Smällvedel	<i>Astragalus penduliflorus</i>	<i>Astragalus penduliflorus</i>	1	Yes	EN	C

## 5.5 Appendix 5: Translations of Swedish legal terms

English translation (as used in this document)	Swedish name
<b>Agencies</b>	
County Administrative Boards	Länsstyrelser
Municipal committees	Kommunal nämnd
Municipalities	Kommuner
Office of the Public Prosecutor	Åklagarmyndigheten
Swedish Association of Local Authorities and Regions	Sveriges kommuner och landsting
The Ministry of the Environment	Miljödepartementet
The Surgeon-General of the Swedish Armed Forces	Generalläkaren
The Swedish Agency for Marine and Water Management	Havs- och vattenmyndigheten
The Swedish Environmental Protection Agency	Naturvårdsverket
<b>Laws &amp; Regulations</b>	
Ordinance on Environmental Supervision (2011:13)	Miljötillsynsförordningen (2011:13)
Ordinance on Protection of Areas in accordance with the Swedish Environmental Code etc. (1998:1252)	Förordningen om områdesskydd enligt Miljöbalken m.m. (1998:1252)
Ordinance on Protection of Species (2007:845)	Artskyddsförordningen (2007:845)
Planning and Building Act (2010:900)	Plan- och Bygglagen (2010:900)
Swedish Environmental Code (1998:808)	Miljöbalken (1998:808)
<b>Legislative terms</b>	
Act	Lag, t.ex. plan & bygglagen
Action Program	Handlingsprogram
EU regulation	EU-förordning
Government bill	Proposition
Legal habitat protection areas	Biotopskyddsområden
Permit matter	Tillståndsärende
Plant sanctuaries	Växtskyddsområden
Regulation, decree, Ordinance (e. g.) the ordinance on...	Förordning
Regulatory agency	Tillsynsmyndighet
Rule, instruction	Föreskrift
Shore protection	Strandskydd
Supervision	Tillsyn
Supervision guidance	Tillsynsvägledning
Wildlife sanctuaries	Djurskyddsområden